

Appendix A
Material Test Reports

MATERIAL TEST REPORT

Metal Samples Company
P.O. Box 8
152 Metal Samples Road
Munford, AL 36268
Ph. (205) 358-4202 Fx. (205) 358-4515

DATE : 08/05/97
PAGE : 1
ORDER: 19898

Customer: 01215 LOCKHEED-IDAHO TECHNOLOGY COMPANY
Your PO#: K97-560272

Lot No. M281 Mill: ALUMIX Our Order Line No. 1
Description: AL6061-T6 .125" X 48" X 144"
Chemical Properties:
Al: BALANCE C: 0.227 Cr: 0.145 Fe: 0.480
Mg: 0.955 Mn: 0.089 Ni: 0.007 Si: 0.644
Ti: 0.021 Zn: 0.048
Physical Properties:
Tensile-PSI: 42,900 Elong-%: 13.2
Yield-PSI: 38,900

Lot No. L261 Mill: LAPHAM HICKEY STEEL Our Order Line No. 2
Description: C1018 .125" X 20.4375"
Chemical Properties:
Al: 0.054 C: 0.163 Cr: 0.018 Fe: BALANCE
Mn: 0.787 Mo: 0.004 N: 0.999 Ni: 0.008
P: 0.010 S: 0.009 Si: 0.010 Ti: 0.001
V: 0.002
Physical Properties:
Not Available

Lot No. L764 Mill: INCO ALLOYS Our Order Line No. 4
Description: I718 .125" X 36" X 60"
Chemical Properties:
Al: 0.620 B: 0.004 C: 0.040 Co: 0.240
Cr: 18.410 Cu: 0.220 Fe: BALANCE Mn: 0.120
Mo: 3.150 Nb: 5.400 Ni: 52.700 P: 0.011
S: 0.002 Si: 0.110 Ta: 0.030 Ti: 1.120
Physical Properties:
Tensile-PSI: 126,000 Elong-%: 49.0
Yield-PSI: 61,000 Condition: ANLD
Hardness: RB 95

Lot No. L708 Mill: J&L SPECIALTY Our Order Line No. 8
Description: 316L .125" X 48" X 120" (4 PCS)



MATERIAL TEST REPORT

DATE : 08/05/97

PAGE : 2

ORDER: 19898

Metal Samples Company

P.O. Box 8

152 Metal Samples Road

Munford, AL 36268

Ph. (205)358-4202 Fx. (205)358-4515

Customer: 01215 LOCKHEED-IDAHO TECHNOLOGY COMPANY

Your PO#: K97-560272

Lot No. L708 (Continued...)

Chemical Properties:

C:0.010	Co:0.140	Cr:16.490	Cu:0.290
Fe:BALANCE	Mn:1.790	Mo:2.060	N:0.034
Ni:10.170	P:0.030	S:0.013	Si:0.380

Physical Properties:

Tensile-PSI:81,900 Yield-PSI:44,000
Hardness:RB 80

Lot No. M398 Mill: TELEDYNE ALBANY

Our Order Line No. 0

Description: ZR4 .124" X 22.125" X 40.250"

Chemical Properties:

Al:38 PPM	B:0.25 PPM	C:146 PPM	Ca:10 PPM
Cd:<0.25 PPM	Cl:5 PPM	Co:<1 PPM	Cr:1190 PPM
Cu:25 PPM	Fe:2210 PPM	H:7 PPM	Hf:64 PPM
Mg:10 PPM	Mn:25 PPM	Mo:10 PPM	N:32 PPM
Na:5 PPM	Nb:50 PPM	Ni:35 PPM	O:1300 PPM
P:8 PPM	Pb:25 PPM	Si:96 PPM	Sn:15400 PPM
Ta:100 PPM	Ti:25 PPM	U:1 PPM	V:25 PPM
W:50 PPM			

Physical Properties:

Not Available

Lot No. L164 Mill: J&L SPECIALTY STEEL

Our Order Line No. 0

Description: 304L .134" X 48" X 9

Chemical Properties:

C:0.020	Co:0.100	Cr:18.230	Cu:0.390
Fe:BALANCE	Mn:1.760	Mo:0.400	N:0.086
Ni:8.250	P:0.030	S:0.016	Si:0.410

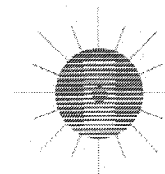
Physical Properties:

Tensile-PSI:89,600 Elong-%:50
Yield-PSI:47,100 Condition:ANLD
Hardness:RB 87

Lot No. L963 Mill: HAYNES INT'L

Our Order Line No. 0

Description: F255 .125X22.75X63.5" 1 PC



**ALABAMA LASER
TECHNOLOGIES**
Innovations for laser manufacturing



**ALABAMA
RESEARCH AND
DEVELOPMENT**

MATERIAL TEST REPORT

DATE : 08/05/97

PAGE : 3

ORDER: 19898

Metal Samples Company

P.O. Box 8

152 Metal Samples Road

Munford, AL 36268

Ph. (205) 358-4202 Fx. (205) 358-4515

Customer: 01215 LOCKHEED-IDAHO TECHNOLOGY COMPANY
Your PO#: K97-560272

Lot No. L963 (Continued...)

Chemical Properties:

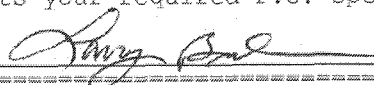
C:0.010	Cr:25.200	Cu:1.940	Fe:BALANCE
Mn:1.040	Mo:3.100	N:0.210	Ni:5.880
P:0.018	S:0.002	Si:0..400	

Physical Properties:

Tensile-PSI:127,000	Elong-%:28.0
Yield-PSI:90,000	Condition:ANLD
Hardness:RC 26	

=====

We certify that the Material Test Report is correct to the best of our knowledge and that the material supplied meets your required P.O. specifications.

THANK YOU, Quality Control Dept. 

=====



ALABAMA
RESEARCH AND
DEVELOPMENT

MATERIAL TEST REPORT

DATE 08/28/97

PAGE I

Metal Samples Company

ORDER: 20213

P.O. Box 8

152 Metal Samples Road Munford, AL 36268

Ph. (205)358-4202 Fx. (205)358-4515

Customer: 01215 LOCKHEED-IDAHO TECHNOLOGY COMPANY

Your PO#: K97-560278

Lot No. M625 Mill:

Our Order Line No. 1.

Description: BERYLLIUM .1251IX31IX3'1 (58 PCS)

Chemical Properties:

Al:0.030 Be:99.000 C:0.050 Fe:0.100 Mg:<0.010 Si:0.020

Physical Properties:

Tensile-PSI:54,200 Elong-%:3.1 Yield-PSI:37,300

We certify that the Material Test Report is correct to the best of our knowledge and that the material supplied meets your required P.O. specifications.

THANK YOU, Quality Control Dept.

Appendix B

Microbial Characterization Techniques

Appendix B

Microbial Characterization Techniques

Materials and Methods

Microbial Isolation

As planned, microbial characterization was performed in accordance with standard microbial practices using aseptic techniques and protocols. The essence of the characterization was to enumerate the population and determine the general types of organisms present. Techniques for both solid media (agar plates) and liquid media (serum bottles) were used. The general types of microorganisms surveyed included those known contributors to microbiologically influenced corrosion, i.e., sulfate-reducing and acid-producing bacteria. Therefore, microbial types of interest were defined as heterotrophic bacteria, in particular those capable of organic acid production, mineral acid producing sulfur oxidizing bacteria (*Thiobacillus thiooxidans*), sulfate reducing bacteria (SRB), and anaerobic nitrate utilizing bacteria (indication of anaerobic environment).

The following procedures were used for the microbial analysis of the coupons.

1. Recover coupon arrays from the Engineered Barrier Test Berm Extension
 - a. Using aseptic methods, carefully locate the ends of each coupon rod in CA1 using known measurements and markers attached to the array.
 - b. Mark out rod and coupon locations.
 - c. Use edger to cut between rods.
 - d. Use drywall knife to cut away side of soil block for sample exposure.
 - e. Cut around and beneath the rod/coupons with drywall knife while keeping the surrounding soil block intact.
 - f. Force the opened side of an appropriate sized collection box onto the isolated soil block.
 - g. Seal the box by securing the lid, mark the box with the proper identification, and double wrap it in two large plastic bags.
 - h. Deliver filled box to site used for analysis.
2. Receive boxed coupon samples from Engineered Barriers Test Berm Extension
 - a. Weigh and record weights of boxed samples plus soils.
3. Recover soil block from boxed samples.
 - a. If a collection of coupons contains a beryllium coupon, conduct work in an operational hood. In the absence of beryllium, use a laboratory bench top.

- b. Cover work area with clean blotter paper.
 - c. Unroll, on the blotter paper, a sterilized "autoclave bag" in a manner to preserve the sterility of the "face up" exposed surface.
 - d. Place the boxed coupon samples on an area adjacent to the sterile working area.
 - e. Remove the lid from the box and rotate the box 180 degrees so that the exposed soil surface is in contact with the sterile work surface.
 - f. Remove soil block from box by disassembling box if necessary.
4. Initial observation of recovered soil block
- a. Collect two soil samples from each soil block for later microbial determination.
 - b. Determine moisture content of soil by collecting ~100 g soil from each of two locations.
 - (1) weigh empty container - record weight
 - (2) weigh container plus soil - record weight
 - (3) dry soil at ~ 80 C for 48 hr
 - (4) reweigh container plus soil - record weight
 - (5) calculate % moisture on a dry weight basis
 - c. Note any intrusion of roots into soil and record.
5. Recover coupon array from soil block.
- a. Using alcohol-swabbed spatulas, begin removing soil attached to coupon array.
 - b. Dispose of removed soil by placing it back into its collection box.
 - c. With most of the soil removed, transfer the coupon array in a sterile manner to the inside of a sterilized "autoclave bag" to which has been added ~20 mL of sterile water to prevent drying. (for the longer arrays slide them into one bag and then place the uncovered end into another bag and pull the unused portion of the second bag over the first bag and then secure the bags together with tape)
6. Recover coupons from array.
- a. Items to be recovered and preserved in a sterile manner include the accompanying Teflon washer and individual coupons.
 - b. Through the open end of the bag (if two bags have been joined together, one end of the double bag will need to be cut open), using sterile techniques, begin to disassemble the coupon array.

- c. After the end nut that secures the array has been removed, remove the Teflon washer with alcohol-swabbed forceps and place it into a small sterile bag.
 - d. In a similar manner, use the forceps to retrieve each coupon; then verify its identification, place it into a sterile bag, and label the bag with the identification of the coupon.
 - e. Stop after the recovery of all the coupons from an array.
 - f. Clean up work area by removing used components of the array, used bags, and blotter paper.
7. Initial analysis for microbial presence.
- a. On an individual basis, visually examine the bagged coupons and note condition, i.e. appearance of corrosion etc.
 - b. If necessary, remove adhering soil with a dry, sterile cotton swab.
 - c. Media to be used for assessing the presence of microorganisms include:
 - (1) nutrient agar with glucose contained in petri dishes
 - (2) phenol red agar with glucose contained in petri dishes
 - (3) heterotrophic liquid contained in serum bottles
 - (4) SRB liquid contained in serum bottles
 - (5) acid indicating liquid contained in serum bottles
 - (6) nitrifying liquid contained in serum bottles
 - (7) thiobacillus liquid contained in serum bottles.
 - d. Using alcohol-rinsed forceps, remove each Teflon washer and coupon from its bag and perform the following:
 - (1) imprint one surface on one petri dish of each of the two different agars
 - (2) swab one half of the other surface with a wet, sterile cotton swab
 - (3) use the swab to streak one each of the two different agars
 - (4) swab the other half of the same surface and replace the coupon back into its individual bag
 - (5) place the second swab into a microcentrifuge vial containing 1 mL of sterile water; vortex the swab - vial to remove adhering fixed cells
 - (6) using a 1 mL syringe, inject 0.1 mL of the water from each vial into each vial of liquid media and shake the contents

- (7) shake the vial and its contents for 15 seconds.
- e. Incubate samples for the required amount of time to allow for microbial growth.
- f. Analyze for the presence of microorganisms.

Required Supplies

- 1 squirt bottle of ethyl alcohol
- 1 vortex mixer
- 4 pairs of forceps
- 48 autoclave bags (24 bench cover, 24 coupon array covers)
- 200 cotton swabs
- 200 nutrient agar with glucose plates (100 10-cm square petri dishes for imprints) (100 10-cm round petri dishes for swabs)
- 100 phenol red agar with glucose plates (for swabs)
- 75 heterotrophic medium serum bottles
- 75 SRB medium serum bottles
- 75 acid medium serum bottles
- 75 nitrifying medium serum bottles
- 75 thiobacilli medium serum bottles
- 75 microcentrifuge bottles with 1 mL sterile water
- 75 1-mL syringes with needles.

Soil Atmosphere Collection

Following are the procedures used to collect soil atmosphere samples near the 4-ft and 10-ft buried coupon arrays.

This procedure was used for the sampling of sealed tubes that have been inserted near the buried coupon array at the Test Berm. The objective of the *in-situ* soil gas recovery was to determine the concentrations of selected *in-situ* soil gases occurring near the buried corrosion coupon testing arrays and at a control site removed from the array, for comparison with each other and with the composition of atmospheric air. The purpose of the analysis was to detect signature gases that indicate microbial activity. The gases of interest were: O₂, CO₂, CH₄, and N₂. The concentrations of these gases were used to infer microbial presence and provide initial evidence if their respiration activity was occurring in an aerobic or anaerobic environment. Knowledge of those conditions, together with soil moisture measurements,

provided presumptive evidence indicating if the coupons were in a microbially induced corrosion (MIC) environment.

The preferred method for analyzing retrieved soil gas samples is to use a field detection system. Field equipment for detection of O₂, CO₂, and CH₄ are commercially available for a cost of ~\$5 K but might be leased. Alternatively, and less desirable, gas samples collected in the field can be transported to a laboratory having suitable detection systems for gas composition analysis.

This protocol for sampling of the soil atmosphere was influenced by procedures co-developed by the Environmental Services Office Air Force Center For Environmental Excellence (AFCEE) and the U. S. Environmental Protection Agency (EPA) (R. E. Hinchee, et al. 1992. Test Plan And Technical Protocol For A Field Treatability Test For Bioventing. Prepared for U.S. Air Force Center For Environmental Excellence, Brooks Air Force Base, TX.; D.C. Downey and J.F. Hall. 1994. Addendum One To Test Plan And Technical Protocol For A Field Treatability Test For Bioventing - Using Soil Gas Surveys To Determine Bioventing Feasibility And Natural Attenuation Potential. Prepared for U.S. Air Force Center For Environmental Excellence, Brooks Air Force Base, TX; Principles And Practices Of Bioventing Volume I: Bioventing Principles. 1995. EPA/540/R-95/534a; Bioventing Principles And Practice Volume II: Bioventing Design. 1995. EPA/625/XXX/001). Procedures for sampling were adapted from the Soil Gas Survey sections of the above manuals.

1. Based on best-at-the-sampling-point procedures, a decision was made on the most appropriate method to fill the sample bag. Each sampling bag was marked with appropriate identification. After sampling was completed and before the sampling line was disconnected from the gas sampling probe, a hose clamp or valve was used to close the sampling tubing to prevent fresh air from being drawn into the soil gas probe.
 - a. Sampling with Vac-U-Tube: The Vac-U-tube consists of an acrylic syringe (2.8 L total volume with a 1.5 L working volume) and plunger with a removable front lid which allows a Tedlar bag to be inserted for collection of an air sample. The specially designed Tedlar bag is precisely sized to fit exactly into the Vac-U-Tube to allow for proper inflation. Fully inflated, the bag holds 0.7 L. A moveable front closure bar on the front of the Vac-U-Tube locks the front lid in place to ensure a proper seal during operation. Before inserting the bag into the tube it is important that (1) the gas inlet/outlet of Vac-U-Tube be inserted into the rubber tube connecting the sampling apparatus with the soil atmosphere vent (this tube should be closed with a clamp prior to this step) and (2) the plunger of the Vac-U-Tube be positioned to a point near the middle of the tube (the center metal band is a good mark). Prior to sample acquisition, the Tedlar bag valve stem is inserted into the Teflon tubing on the inside of the Vac-U-Tube removable front lid. Once the bag is in place, the bag valve is opened (hence the need for having the gas sampling tube clamped shut) before inserting the bag into the Vac-U-Tube. The bag is then inserted into the tube with a slight bend along its length to allow proper inflation. With the bag inserted into the tube and the front lid in place, the front closure bar is positioned to seal the tube, and the sampling tube is unclamped. Using a slow steady movement, the plunger is then pulled back and the bag inflated. With the Tedlar bag inflated, the sample tube is resealed, the front closure bar is positioned to release the front lid, and the lid with attached bag is removed. The bag valve is then closed and the bag stem is removed from the Teflon tubing of the front lid. The filled bag is placed into a sturdy container (such as a box or cooler) to protect it from being punctured.

2. Using the above procedure, several gas samples from each sampling port were obtained so that a determination was made when an equilibrium concentration of the soil gas was being analyzed, i.e., the 9 ft sample probe has a void volume of approximately 500 mL; that of the 4 ft probe is 300 mL. Because of a limited number of sample collection bags, four 700 mL collections were taken at the 4-ft level and three at the 9 ft level.
3. Flush the sampling tubing with an atmospheric gas mixture between each sampling operation.
4. Continue to obtain samples from all the selected 4 and 9 ft sampling probes. Data on the identity of the sampling bag and progress of the procedure were recorded.
5. Filled sampling bags were protected from excise heat to prevent increased internal pressure and possible over expansion.
6. Analysis of gas from the filled bags took place within three weeks after collection.

Appendix C

Vertical Scanning-Interferometry Measurements

Date: 08/02/99
Time: 08:15:1

Mag: 2.5 X
Mode: VSI

3-D Plot



Surface Statistics:

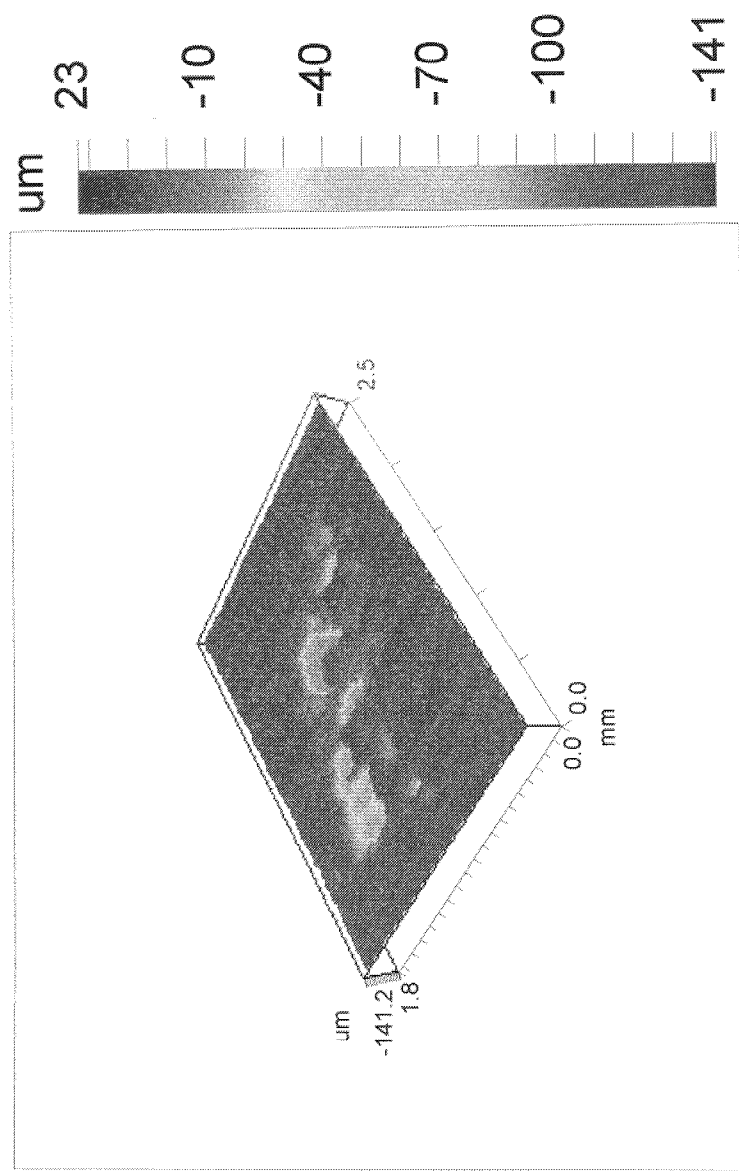
Ra: 9.68 μm
Rq: 17.79 μm
Rz: 153.25 μm
Rt: 164.05 μm

Set-up Parameters:

Size: 736 X 471
Sampling: 3.38 μm

Processed Options:

Terms Removed:
Tilt
Filtering:
None



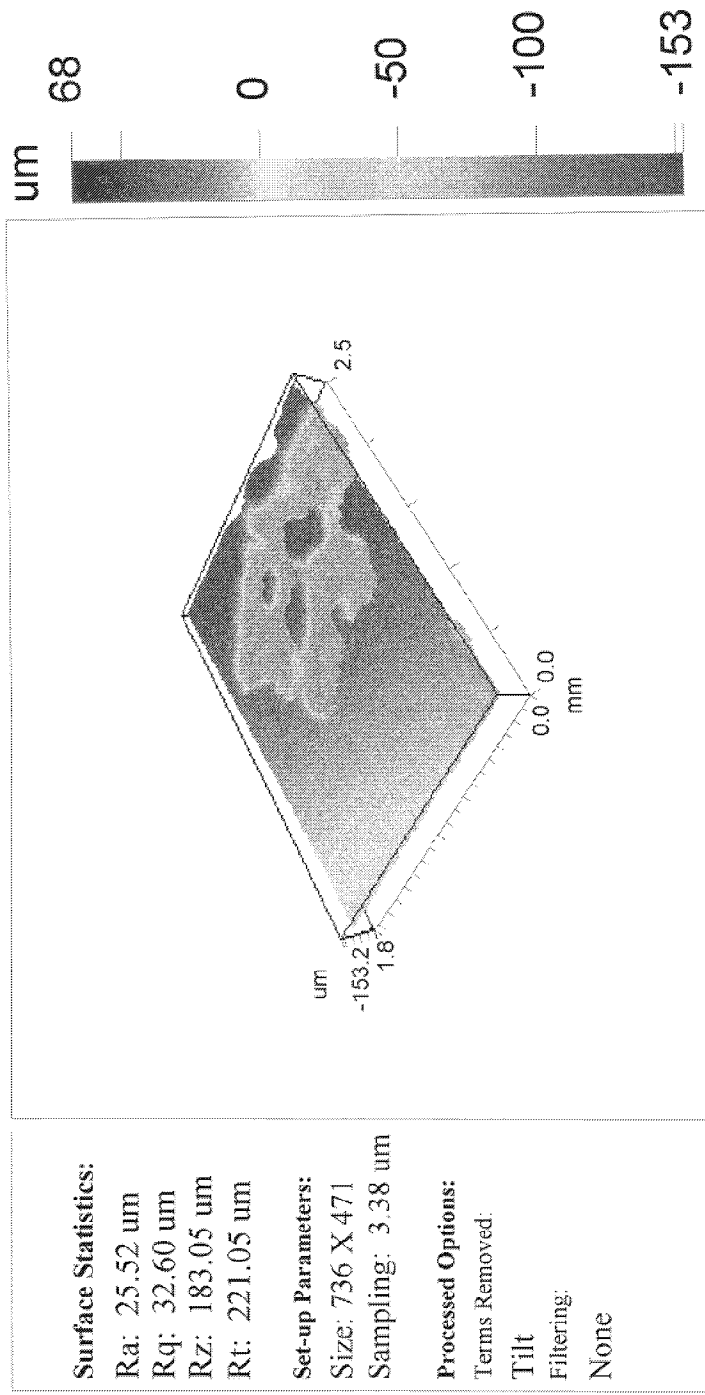
Title: Coupon #3323 C.S.
Note: Area #2 Stamped Side



Mag: 2.5 X
Mode: VSI

Date: 09/08/99
Time: 14:25:1

3-D Plot



Title: Be Coupon #2
Note: Front (Stamped Side) Area #1